

Application No. 10/518,443
Amendment dated November 2, 2006
Reply to Office Action of June 2, 2006

Docket No.: 0315-0158PUS1

AMENDMENTS TO THE DRAWINGS

The attached sheet(s) of drawings includes changes to Fig. 2.

Attachment: Replacement sheet

REMARKS

The Abstract of the Disclosure has been resubmitted as suggested by the Examiner.

Fig. 2 has been labeled as “Conventional Art” and thus it is believed that the Examiner’s objection to Fig. 2 has been eliminated.

Claims 1, 11, 12, 15, 33, 34, 39, 40, 43, and 44 have been objected to for the reasons set forth in paragraph 3 of the Examiner’s Office Action letter. As the Examiner will note, the present Amendment addresses all of the objections raised by the Examiner as well as other informal matters, and accordingly, it is believed that this objection has been eliminated.

Claims 1-47 have been rejected by the Examiner under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regard as the invention. This rejection is respectfully traversed.

As the Examiner will note, all of the matters raised by the Examiner in paragraph 4 of the Office Action letter have been addressed by the present Amendment, and accordingly, it is believed that this rejection has been eliminated.

Claims 36-47 have been rejected by the Examiner under 35 USC 101, because the claimed recitation of a use without setting forth any sets involved in the process is considered to result in an improper definition of the process. As the Examiner will note, claim 36 has been cancelled from the present application and replaced with newly added claim 51 and all of the claims which were dependent from claim 36 are now dependent from newly added claim 51. Accordingly, it is believed that all of the issues raised by the Examiner in connection with the rejection of claims 36-47 have been eliminated by the amendments made to the existing claims as well as the submission of newly added claims 48-51.

Claims 1-47 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over Luciani et al., EP 0 480 435 (hereinafter referred to as Luciani I). Claims 1-47 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over Luciani et al. EP 0 522 651 (hereinafter referred to as Luciani II). Claims 1-47 are further rejected by the Examiner under 35 USC 103(a) as being unpatentable over WO91/08239 (hereinafter referred to as Neste). These rejections are respectfully traversed

The Examiner states that no evidence has been provided which might show that the invention according to Lucian I, Lucian II and Neste differs from that of the present application. The thermal step (g) and the washing step (h) are considered by the Examiner as the only differences between the present invention and the prior art.

However, the Applicants wish to point out that the inventiveness of the present invention does not reside exclusively in steps (g) and (h) as stated by the Examiner, but more specifically in the composition of the catalyst which contains Ti, Mg, Cl, alkoxy groups and organometallic compounds and in the use of a non-polar organic solvent to impregnate the particular silica in step (a), which produces a catalyst having a different behavior which in turns produces a different final product in the ethylene polymerization and copolymerization process. In this connection, claims 1, 8, 10, 14 and 16 were combined in the newly added claim 48 and claims 1, 8, 10, 14 and 16 have been cancelled from the present application.

In order to demonstrate the technical effects of the present invention over Luciani I, the Applicants present herein below the results of the test conducted to compare the properties of polymers obtained by polymerization or copolymerization processes using catalysts prepared according to Luciani I or the present invention. These test results can be presented in the form of a declaration under 37 CFR 1.132 if the Examiner considers this to be necessary.

The new tests described herein below have been carried out using exactly the same polymerization conditions employed in the examples of Luciani I, but using different catalytic systems: catalyst according to Example 1 of Luciani I or catalyst according to Examples 11 or 12 of the present application.

Comparative Test Number	1	2
Product	HDPE	HDPE
Catalyst used	Ex. 1 of Luciani I	Ex. 11 of the present application
Alkyl-aluminum	TEAL	TEAL
Catalyst mass (mg)	60	60
Temperature (°C)	90	90
Time (h)	2	2
Al/Ti	70	70
H ₂ /C ₂	0.47	0.47

Activity (KgPol/gTi)	4.2	3.0
Bulk Density (g/cm ³)	0.32	0.40
MIF(2:16) (g/10min)	2.84	0.9
Density (g/cm ³)	0.9563	0.9632

Comparative Test Number	3	4
Product	LLDPE	LLDPE
Catalyst used	Ex. 1 of Luciani I	Ex. 12 of present application
Alkyl-aluminum	TEAL	TEAL
Catalyst mass (mg)	60	60
Temperature (°C)	75	75
Time (h)	3	3
Al/Ti	300	300
C ₄ (ml)	290	290
H ₂ /C ₂	0.40	0.40
Activity (KgPol/gTi)	3.0	6.6
Bulk Density (g/cm ³)	0.26	0.36
Mesh 250 + bottom (%)	2.8	0.1
MIF(2:16) (g/10min)	0.40	0.91
Content of binded butene (%)	4.7	8.7
Density (g/cm ³)	0.9283	0.9170

The above results, relative to the tests 2 and 4, show a higher bulk density a lower amount of fines and better comonomer insertion (test 4 only) for the polymers obtained according to the present invention.

In connection with Luciani II, the following differences can be observed when compared to the present invention:

- Feature 1:** the organometallic compound, which in Luciani II is also the chlorinating agent, is impregnated into the support separately in step (a) and an additional halogenating (chlorinating) agent is employed in step (f).
- Feature 2:** the ratio of the amount of silica support to catalyst component used;
- Feature 3:** the ratio of the amount of silica support hydroxyl groups to organometallic component(s) used and the nature of said components;
- Feature 4:** the ratio of the amount of silica to magnesium component used;
- Feature 5:** a reducing agent is present;
- Feature 6:** no additional $TiCl_4$ is employed;
- Feature 7:** the organic solvent used during the impregnation of the activated silica is non-polar;
- Feature 8:** the supernatant liquid from step (a) is removed by means of settling, siphoning, filtration or centrifugation (Luciani II makes use of evaporation);
- Feature 9:** an additional washing step is employed (step (h)).

The above features lead to the improved catalytic system of the present invention which is not excessively active at the start-up of polymerization but shows similar final activity, thus providing polymers with good morphology and also with enhanced properties, as a consequence of good comonomer insertion.

In order to demonstrate the technical effect of these features over Luciani II, the Applicants present hereinbelow the results of new tests recently conducted which essentially compare the properties of polymers obtained by polymerization or copolymerization processes using catalysts prepared according to Luciani I and the present invention.

It is important to bear in mind that Luciani II performed tests exclusively for HDPE (density higher than 0.95 g/cm³), in which case only Example 11 of the present invention may be compared to the results of Luciani II. The polymer of Example 11 shows a bulk density of 0.48 g/cm³, while the polymer of Lucian I has a bulk density of 0.39 g/cm³.

The new tests described hereinbelow were carried out using exactly the same polymerization condition employed in the examples of Luciani II, but using different catalytic systems: catalyst according to Ex. 1 of Luciani II (test 5), catalyst according to Ex. 4 of Luciani II (test 6) and catalyst according to Ex. 11 of the present patent application (test 7).

The results obtained in tests 5 and 6 are quite similar to the corresponding ones presented in Luciani II, which show the correction of Applicants' proceedings.

The higher bulk density and the low quality of fines obtained in test 7 show the superiority of the polymer prepared according to the present invention. The value obtained for the bulk density (0.40 g/cm³) is within the range of 0.33-0.438 g/ml considered by US 5,585,317 as distinctive of HDPE having good morphology (see page of the present specification).

Comparative Test Number	5	6	7
Product	HDPE	HDPE	HDPE
Catalyst used	Ex.1 of Luciani II	Ex.4 of Luciani II	Ex.11 of the present application.
Alkyl-aluminum	TEAL	TEAL	TEAL
Catalyst mass (mg)	60	60	60
Temperature (°C)	90	90	90
Time (h)	1.5	1.5	1.5
Al/Ti	50	50	50
H ₂ /C ₂	0.47	0.47	0.47

Activity (KgPol/gTi)	37.0	109.0	100.0
Bulk Density (g/cm ³)	0.30	0.32	0.40
Mesh 250 + bottom (%)	-	7.12	0.17
MIIF (2.16) (g/10min)	2.51	2.46	0.9
Density (g/cm ³)	0.9592	0.9572	0.9632

Similarly, new tests have been carried out for LLDPE using different catalysts of Lucian II (tests 8 and 9) and of the catalyst of the present invention (test 10) and following the polymerization conditions employed in Example 12 of the present application, since Luciani II itself does not present any test for LLDPE.

Comparative Test Number	8	9	10	11
Product	LLDPE	LLDPE	LLDPE	LLDPE
Catalyst used	Ex.1 of Luciani II	Ex.4 of Luciani II	Ex.12 of the present application.	Ex.1 of Luciani II
Alkyl-aluminum	TEAL	TEAL	TEAL	TEAL
Catalyst mass (mg)	60	60	60	60
Temperature (°C)	75	75	75	75
Time (h)	3	3	3	3
Al/Ti	300	300	300	300
C ₄ (ml)	290	290	290	700
H ₂ /C ₂	0.47	0.47	0.47	0.40

Activity (KgPol/gTi)	74	300	330	76
Bulk Density (g/cm ³)	0.26	0.30	0.36	0.28
Mesh 250+ bottom (%)	-	3.0	0.1	0.1
MIF (2:16) (g/10min)	1.00	1.30	0.91	1.34
Content of binded butene (%)	5.7	6.7	8.7	9.7
Density (g/cm ³)	0.9382	0.9251	0.9170	0.9187
Xylene solubles (%)	5.3	7.3	9.7	14.2

The polymer prepared according to the present invention produces better comonomer insertion (50% more butane incorporated in test 10 comparing to the value of test 9), higher bulk density and lower amount of fines. Once again, the bulk density obtained (0.36 g/cm^3) is within the range provided by US 5,585,317 upon describing LLDPE with good morphology.

In the test number 11, Applicants use a catalyst in accordance with Luciani II and change the process conditions, particularly the amount of butene in the reaction medium, in order to obtain a final product having a density very similar to that of the product of test 10, in which a catalyst according to the present invention is employed.

The butene is so badly distributed in the molecule of test 11 that the content thereof should be much higher so that the desired low density is obtained. The bad comonomer insertion also produces a lower amount of solubles, when compared to the result of test 10, in connection therewith, please note that the soluble amounts of the products obtained in tests 8 and 9 are lower than that of test 10 simply because their densities are higher than the density of the product obtained according to the present invention (test member 10).

The low amount of fines obtained in test 11 (0.1%) is due to the great quantity of solubles which leads to a sticky product in which the small particles remain joined together. In addition, the amounts of Ti, Mg, and Cl employed in the catalyst according to the present invention are quite lower than those of Luciani II, as shown in the table hereinbelow.:

	Luciani II	Present application	Differences
Ti	3-5 %	0.5-2 %	50 to 150 %
Mg	3-5 %	0.3-3 %	0 a 66 %
Cl	15-20 %	5-12 %	25 a 67 %
Al	1-5 %	0.3-3 %	Within the same range
OBu	Range not mentioned	3-8 %	-

Similar differences can be observed when comparing the catalyst of Neste with the present invention as illustrated in the Table below:

	Neste	Present application
Ti	2.2-4.8 %	0.5-2 %
Mg	0.7-1.75 %	0.3-3 %
Cl	12.7-29.7 %	5-12 %
Al	2.2-9.7 %	0.3-3 %

Upon analyzing the polymerization results in Neste,. One can observe that the greatest density obtained is 0.36 g/cm³ for HDPE and 0.31g/cm³ for LLDPE.

Clearly, the Applicants have demonstrated hereinabove, a catalyst which is unique in its nature because of the process by which it is produced and, as such, is effective in producing polymers and copolymers of polyethylene with narrow molecular weight distributions of high density polyethylene and linear low density polyethylene which possess both a controlled morphology and improved structure. The present invention contains many features which are effective in producing the Applicants' inventive contribution and as pointed out hereinabove, the prior art relied upon by the Examiner fails to show many of the features recited in the claims of the present application.

Accordingly, in view of the above amendments and remarks, reconsideration of the rejections and allowance of the claims of the present application are respectfully requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Joseph A. Kolasch Reg. No. 22,463 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

By 
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Attachments: Replacement Fig. 2